What is claimed is:

1. A video transcoding apparatus comprising:

a video decoder receiving to decode a compressed video bit stream so as to restore a pixel value of an original scene;

a video pre-processing unit having a predetermined matrix structure and down-sampling a macro block decoded by the video decoder by transforming the macro block into a corresponding picture structure to the compressed video bit stream;

a frame memory storing the down-sampled macro block;

a transcoding parameter control unit detecting information about a picture from a previous bit stream variable-length-decoded by the video decoder and setting up an encoding mode for a transcoding in accordance with the detected information;

a video encoder encoding down-sampled data stored in the frame memory by macro block unit in accordance with the encoding mode outputted from the transcoding parameter control unit; and

a bit rate control unit controlling quantization of the video encoder by calculating a bit amount encoded substantially by every picture among a bit stream to be decoded currently by the video decoder and finding a

fullness of a buffer in the video encoder using the calculated bit amount.

2. The apparatus of claim 1, wherein the video pre-processing unit carries out a down-sampling through a field based processing if the data decoded in the video decoder is an interlacing sequence and the macro block having a frame picture or through a frame based processing if the data decoded in the video decoder is a sequential scanning sequence or an interlacing sequence having a field picture structure so as to maintain information of field unit.

3. The apparatus of claim 2, wherein the video pre-processing unit transforms an 8x8 block outputted from the video decoder into a 4x4 block using a following matrix:

$$\begin{bmatrix} y \\ y \\ y \\ y \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \left[P4^T\right] = \begin{bmatrix} X0 \\ X1 \\ X2 \\ X3 \\ X4 \\ X5 \\ X6 \\ X7 \end{bmatrix}, \text{ where } [P4] = \begin{bmatrix} T4 & 0 \\ 0 & 0 \end{bmatrix} / \sqrt{2},$$

[T4] is a 4-point DCT-based 4*4 DCT matrix, y denotes down-sampled 4x1 pixels, and X is 8 DCT coefficient blocks.

4. The apparatus of claim 3, wherein the video pre-processing unit carries out an 1-dimensional down-sampling using a following matrix:

$y_{[4\times1]} = C_4^T \cdot X_{[8\times1]} = [T4^T \quad 0]/\sqrt{2} \cdot [T8] \cdot x_{[8\times1]}$, where x represents 8x1 pixels, y denotes down-sampled 4x1 pixels, and X is a DCT coefficient block for x. T8 is a 8x8 DCT based matrix, $C_4 = \begin{bmatrix} T4 \\ 0 \end{bmatrix} / \sqrt{2}$, and C_4 is a 4x4 DCT based matrix.

5. The apparatus of claim 3, wherein the video pre-processing unit carries out a down-sampling of a luminance signal using a following matrix:

$y_{[4\times1]} = C_{4\times8} \cdot x_{[8\times1]}$, where $C_{4\times8} = C_4^T \cdot T8$ is a 4x8-dimensional down-sampling matrix and converts 8 pixels into 4 pixels.

6. The apparatus of claim 3, wherein the video pre-processing unit carries out a down-sampling of a chrominance signal using a following matrix:

$y_{2\times1} = C_{2\times4} \cdot x_{[4\times1]}$, where $C_{2\times4} = [T2 \quad 0]^T \cdot T4\sqrt{2}$ and T2 is a 2*2 DCT based matrix.

7. The apparatus of claim 1, wherein the transcoding parameter control unit establishes a motion vector and a

motion mode of the macro block down-sampled by the video pre-processing unit using a motion information of a previous bit stream variable-length-decoded by the video decoder.

8. The apparatus of claim 1, wherein the transcoding parameter control unit establishes a following video encoding reference and then set up encoding parameters for a low resolution video of the video encoder based on the encoding reference:

1) maintain a decoded picture coding type;

2) maintain a decoded picture structure;

3) maintain a decoded GOP(group of pictures);

4) vary a decoded motion type or a macro block type;

5) vary a decoded quantizing parameter;

6) vary a decoded motion vector; and

7) vary a decoded VBV_delay and a decoded VBV_buffer_size.

9. The apparatus of claim 8, wherein the transcoding parameter control unit controls the video encoder so as to intra-code macro blocks outputted from the frame memory if a currently-decoded picture coding type outputted from the video decoder is an I picture.

10. The apparatus of claim 8, wherein the transcoding parameter control unit determines whether to carry out a motion compensation through types of previously-decoded macro blocks corresponding to the macro block to be encoded currently if the currently-decoded picture coding type outputted from the video decoder is a P or B picture.

11. The apparatus of claim 10, wherein the transcoding parameter control unit controls the video encoder so as to intra-code the macro block to be encoded currently if at least three intra macro blocks exist in the previously-decoded four macro blocks corresponding to the macro block to be encoded currently.

12. The apparatus of claim 10, wherein the transcoding parameter control unit controls the video encoder so as to intra-code the macro block to be encoded currently if two macro blocks in a diagonal direction among four previously-decoded macro blocks corresponding to the macro block to be encoded currently are at intra mode.

13. The apparatus of claim 10, wherein the transcoding control unit judges that a motion compensation is necessary if there are other conditions except those described in claims 11 and 12, and then distinguishes the P and B pictures from each other with the picture coding type.

14. The apparatus of claim 13, wherein average and median values of motion vectors of the previously-decoded macro blocks corresponding to the macro block to be encoded currently are found for the P picture and then the motion vector having a less mean absolute error(MAE) found from two vectors defined by the average value and median value respectively is selected as a motion compensating vector.

15. The apparatus of claim 14, wherein the video encoder encodes the macro block to be encoded currently as the intra mode if the selected MAE is over a predetermined value, and wherein the video encoder carries out the motion compensation by setting up the macro block type and the motion type fitting for the P picture if the selected MAE is less than the predetermined value and

then encodes a difference between the motion-compensated macro block and the macro block to be encoded currently.

16. The apparatus of claim 13, wherein average and median values of forward and backward motion vectors of the previously-decoded macro blocks corresponding to the macro block to be encoded currently are found for the B picture and then a motion vector at a least one of mean absolute errors(MAE) found from four vectors defined by the average and mean values is selected as a motion compensating vector.

17. The apparatus of claim 16, wherein the video encoder encodes the macro block to be encoded currently as the intra mode if the selected MAE is over a predetermined value, and wherein the video encoder carries out the motion compensation by setting up the macro block type and the motion type fitting for the B picture if the selected MAE is less than the predetermined value and then encodes a difference between the motion-compensated macro block and the macro block to be encoded currently.

18. The apparatus of claim 1, the bit rate control unit comprising:

a picture bit counting unit calculating a bit amount encoded substantially for each picture in a video bit stream which is inputted to the video decoder and to be encoded currently;

a buffer in the video encoder finding a target bit number for a picture to be encoded using the bit amount calculated by the picture bit counting unit and a video bit stream variable-length-coded in the video encoder and then calculating the fullness of the buffer in the video encoder using the found target bit number;

a reference quantizing parameter calculating unit calculating a reference quantizing parameter in accordance with the buffer fullness outputted from the buffer;

an activity calculating unit producing an activity of a video outputted from the video decoder; and

a quantizing parameter generating unit generating a quantizing parameter to be used for a substantial quantization in accordance with the calculated reference quantizing parameter and the calculated activity so as to control a quantization of the video encoder.

19. The apparatus of claim 18, wherein the picture bit counting unit detects a picture start code picture_start_code in the video stream inputted to the

video decoder and counts to output a bit number between the detected picture start code and a next picture start code.

20. The apparatus of claim 18, wherein the buffer finds the target bit number $T_2(k)$ in one picture of the video stream to be encoded currently using a following formula:

$T_2(k) = T_1(k) \times \frac{R_2}{R_1}$, *where* $k \in \{i, p, b\}$, $T_1(k)$ is the target bit number to allocate k-picture to GOP and is found in the picture bit counting unit, R_1 is a bit rate of one sequence of the video stream inputted to the video decoder, and R_2 is a bit rate of one sequence of the video stream to be encoded.

21. The apparatus of claim 20, wherein the buffer finds the buffer fullness (d_j^i, d_j^p, d_j^b) of the respective pictures using a following formula:

$$d_j^i = d_0^i + B_{j-1} - \left\{ \frac{T_{2i} \times (j-1)}{MB\_cnt} \right\};$$

$$d_j^p = d_0^p + B_{j-1} - \left\{ \frac{T_{2p} \times (j-1)}{MB\_cnt} \right\}; \text{ and}$$

$$d_j^b = d_0^b + B_{j-1} - \left\{ \frac{T_{2b} \times (j-1)}{MB\_cnt} \right\},$$

where each of d_0^i, d_0^p, d_0^b shows an initial fullness of a buffer of each of the pictures,

B_j is a bit number generated from encoding macro blocks up to the present including j, and MB_cnt represents total number of the macro blocks in the picture.

22. The apparatus of claim 18, wherein the activity calculating unit receives an output of the frame memory, finds the activity of the macro block to be encoded currently, normalizes the activity, and outputs the normalized activity to the quantizing parameter generating unit, and wherein an initial value of an average value of the activities used for the activity normalization is set up by finding an average activity of a macro block to be decoded into an original resolution.

23. A video transcoding apparatus comprising:

a video decoder receiving to decode a compressed video bit stream through variable length decoding, inverse quantization, inverse DCT, and motion compensation processes, carrying out a down-sampling for a conversion to a different bit rate to output a down-sampled video, carrying out an up-sampling on the down-sampled video, and carrying out a motion compensation on the up-sampled video;

a frame memory storing the down-sampled macro block;

a transcoding parameter control unit detecting information about a picture from a previous bit stream variable-length-decoded by the video decoder and setting up an encoding mode for a transcoding in accordance with the detected information;

a video encoder encoding down-sampled data stored in the frame memory by macro block unit in accordance with the encoding mode outputted from the transcoding parameter control unit; and

a bit rate control unit controlling quantization of the video encoder by calculating a bit amount encoded substantially by every picture among a bit stream to be decoded currently by the video decoder and finding a fullness of a buffer in the video encoder using the calculated bit amount.

24. The apparatus of claim 23, wherein the video decoder carries out the down-sampling through a field based processing if the decoded data is an interlacing sequence and the macro block having a frame picture, or a frame based processing if the decoded data is a sequential scanning sequence or an interlacing sequence having a field picture structure so as to maintain information of field unit.

25. The apparatus of claim 23, wherein the transcoding parameter control unit controls the video encoder so as to intra-code macro blocks outputted from the frame memory if a currently-decoded picture coding type outputted from the video decoder is an I picture.

26. The apparatus of claim 23, wherein the transcoding parameter control unit determines whether to carry out an intra coding or a motion compensation through types of previously-decoded macro blocks corresponding to the macro block to be encoded currently if the currently-decoded picture coding type outputted from the video decoder is a P or B picture.

27. The apparatus of claim 26, wherein average and median values of motion vectors of the previously-decoded macro blocks corresponding to the macro block to be encoded currently are found for the P picture and then the motion vector having a less mean absolute error(MAE) found from two vectors defined by the average value and median value respectively is selected as a motion compensating vector, and wherein the macro block to be encoded currently is encoded as the intra mode if the

selected MAE is over a predetermined value and wherein the video encoder carries out the motion compensation by setting up the macro block type and the motion type fitting for the P picture if the selected MAE is less than the predetermined value and then encodes a difference between the motion-compensated macro block and the macro block to be encoded currently.

28. The apparatus of claim 26, wherein average and median values of forward and backward motion vectors of the previously-decoded macro blocks corresponding to the macro block to be encoded currently are found for the B picture and then a motion vector at a least one of mean absolute errors(MAE) found from four vectors defined by the average and mean values is selected as a motion compensating vector, and wherein the macro block to be encoded currently is encoded as the intra mode if the selected MAE is over a predetermined value and wherein the motion compensation is carried out by setting up the macro block type and the motion type fitting for the B picture if the selected MAE is less than the predetermined value and then encodes a difference between the motion-compensated macro block and the macro block to be encoded currently.

29. The apparatus of claim 23, the bit rate control unit comprising:

a picture bit counting unit detecting a picture start code picture_start_code in the video stream inputted to the video decoder and counting a bit number between the detected picture start code and a next picture start code so as to calculate a bit amount encoded substantially for each picture in a video bit stream which is inputted to the video decoder and to be encoded currently;

a buffer in the video encoder finding a target bit number for a picture to be encoded using the bit amount calculated by the picture bit counting unit and a video bit stream variable-length-coded in the video encoder and then calculating the fullness of the buffer in the video encoder using the found target bit number;

a reference quantizing parameter calculating unit calculating a reference quantizing parameter in accordance with the buffer fullness outputted from the buffer;

an activity calculating unit producing an activity of a video outputted from the video decoder; and

a quantizing parameter generating unit generating a quantizing parameter to be used for a substantial

quantization in accordance with the calculated reference quantizing parameter and the calculated activity so as to control a quantization of the video encoder.